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Survey Examines Challenges with Shared Resource Facilities

Shared resource facilities provide greater access of resources to researchers, and make strategic and efficient use of funding mechanisms. Released earlier this month, the Federation of American Societies For Experimental Biology's (FASEB) *Maximizing Shared Resources* report consisted of the results of a 54 question survey of 751 respondents that were principal investigators (34%), facility/center directors (32%), facility/center staff (16%),

graduate/postdoc/fellowship students (12%) and lab staff (7%). Shared resource facilities, which the FASEB describes as "cores, stock centers, and user facilities at the National Laboratories," provide additional benefits to cost savings and access by offering specialized expertise, quality control and specialized research opportunities, technology development and technical training, as well as by serving as a hub for collaborative science research. According to the FASEB, shared research resources use research funds effectively and can help provide access to cutting edge technologies. As the FASEB stated in its report, "through shared resource facilities, the research community can promote rigorous research practices, quality technical training and collaborative research."

The survey questions looked at four major topics: utilization of resources and identification of unmet needs; facilities' role in providing resource access; sources of funding and resources support for facilities; and resource provision careers and quality training for staff. The *Maximizing Shared Resources* report also included a section on FASEB recommendations for the challenges faced by shared resource facilities.

In examining the survey results, the FASEB determined four key challenges based on the four question topics for improving shared resource facilities. These are: funding and business operations; discoverability and access; the ability to meet evolving needs; and facility career track and staff development.

Funding and Business Operations

Funding greatly varies amongst research institutions and departments and, as the report indicated, funding from federal sources is unstable due to its inconsistency. This is exacerbated by the variability of funding, as federal grants are used for specific types of support in research facilities (i.e., instrumentation, research or center grants). Almost a third of respondents, or 31%, noted that the annual income of their facilities were "moderately variable" or "highly variable," with regional facilities having greater discrepancies in their funding rates.

> ***"The high variation among grant programs in what types of resources and associated costs are funded leads to gaps in support."***

Although certain shared resource providers have attempted to diversify income streams to their respective facilities, due to federal polices and regulations, many were unable to offer services to outside users. Many federal agencies are examining and adjusting resource programs to tackle these concerns. The NSF, for example, issued a request for information earlier this month regarding mid-scale research infrastructure needs for the purpose of developing a strategy to ensure that mid-scale projects do not fall in between eligibility thresholds of NIH programs for funding research infrastructure.

"The NSF [planning] to establish support for mid-scale infrastructure is an excellent example of the type of gaps that exist in federal grant programs," said Sheenah M. Mische, PhD. Dr. Mische serves as the chair of the FASEB's Shared Resource Committee, and is also senior director, Division of Advanced Research Technologies, and associate professor (Research) in the Department of Pathology at New York University Langone Health. She explained that many of the NSF programs are concentrated on meeting the requirements of specific disciplines or a group of scientists. "However, shared resource facilities often serve researchers in many different fields, and many researchers utilize multiple facilities," she said. "The high variation among grant programs in what types of resources and associated costs are funded also leads to gaps in support. We need greater coordination and strategic planning across all resource grant programs to ensure efficient and effective use of funds."

In the recommendations section of the report, the FASEB suggested improving business models for shared resource facilities by customizing them for specific technologies and services. Also, to ensure federal funds are maximized, the FASEB recommended that federal agencies improve the funding programs that support shared resource facilities.

Other mechanisms, such as refurbished equipment, are also alternative ways for facilities to procure instruments. "Industry partnerships are always welcome," Dr. Mische added. "[F]acilitating access to new platforms to assess applicability for the research project or to collect pilot data for grant applications would be of particular help."

Discoverability and Access

Of great importance for facility discoverability and access, the FASEB report noted, is ensuring that shared resources are financially sustainable, and that investigators are able to easily locate and utilize them. However, as indicated by the survey results, access is a major challenge for researchers, with just below 50% of respondents stating their desire to utilize a facility but being unable to do so over the past five years. This is due to being unable to identify a facility that would meet their needs, high usage costs, inadequate capacity and restrictions on utilization access. In fact, the survey indicated that 95% of respondents use word-of-mouth in their search for an appropriate facility. Moreover, 57% refer to institutional facility lists, while 52% search online, leaving only 21% and 17% of respondents who use a facilities database or a commercial service provider, respectively.

Research institutions would be able to greatly increase productivity and increase competitiveness amongst their investigators by ensuring that investigators can easily find the resources and access they require, according to the report. However, survey respondents indicated minimal availability of resource-related programs at their institutes, and less than half of respondents belong to an organization that reaches out to faculty and researchers about facilities that are available.

Even if a researcher is able to locate the appropriate facility for their project, many researchers are unable to afford facility fees; in fact, according to the survey results, lowering facility fees was listed as the most important need by unfunded researchers applying for grants and investigators at institutes that are less research intensive.

The FASEB recommended that government agencies increase the awareness of shared resource facilities and providers through a national database, connect researchers with the institutional resources they need, and establish better funding mechanisms that cover fees for unfunded investigators and other researchers that are unable to utilize facilities due to high fees.

Ability to Meet Evolving Needs

Evolution is key for a facility to meet changing research needs and advancing technologies. Replacing or upgrading equipment, training staff appropriately and improving workflows are some of the ways facilities can address evolving needs, according to the FASEB report. However, adequate funds are needed in order to implement these actions, and this is a hurdle for many facility directors.

Additional funding is not the only solution to this challenge, as the FASEB calls this issue “multifaceted.” Many times, procuring instruments requires that facilities obtain instruments through external sponsors or the institution itself, but very few federal instrument grants are awarded each year and the grants themselves are largely insufficient, according to survey respondents.

“When asked what specific resource they would most like to use in their own research, survey respondents overwhelmingly described instruments and services that are typically provided through facilities,” said Dr. Mische. However, as indicated in the FASEB’s report, facilities frequently struggle to achieve this. “For example, many facility personnel reported difficulty securing capital funding for new instruments and maintaining existing ones, limiting the facility’s capacity to serve researchers,” Dr. Mische continued. “Insufficient support also can limit expertise and the range of services available; a number of shared resource core directors stated that they were unable to obtain funding for staff development or protected time to create and implement new protocols.”

> ***“[Instrument companies’] assistance promotes rigorous and reproducible research, especially when companies contribute to and share best practices with the user community.”***

In order to combat this issue, Dr. Mische explained that shared resource scientists must be able to improve, replace or acquire new instruments, and that, in and of itself, requires an improved, more sustainable business model. In order to do this, Dr. Mische pointed out that survey respondents suggested that facilities secure various income streams and maintain a broad user base. “Facility directors also need to continuously engage with other researchers to identify emerging needs,” added Dr. Mische.

As indicated in the report’s recommendations, through improved coordination of federal support for shared

resources, implementation of long-term strategic planning at institutions and ensuring that staff expertise and services are up-to-date, federal funding can be maximized and therefore more effective, resulting in the facility keeping up with evolving needs.

Facility Career Track and Staff Development

Although facility directors, core scientists and technical staff have significant roles in facilities, their career tracks are many times discounted, resulting in a lack of support for their goals of accelerating scientific research and recruiting expert staff. This can result in lower-quality services at the facility and a high turnover of personnel, ultimately reducing the cost efficiency of the facility, according to the FASEB.

The FASEB recommended that investigators acknowledge shared resource facilities and recognize the facility personnel, as well as provide greater job security for the staff, such as offering training and development grants.

Instrument companies can play a key role in supporting shared resource facilities, especially when it comes to training. “Companies can help by informing their customers about new applications and protocols for their equipment.” Partnering with FASEB member societies, such as the Association for Biomolecular Research Facilities, is a way that companies can promote training and education on emerging technologies, she noted.

As Dr. Mische indicated, regardless of whether they were facility users or facility providers, 92% of survey respondents deemed staff expertise as indispensable. “Companies can assist by ensuring that training for instrumentation is part of the purchase agreement and follow-up training also is available,” she said. “Additionally, companies can make comprehensive training materials for their instruments freely available and easy to find. These actions can help facilities implement new protocols as well as maintain continuity during staff turnover.”

The support provided by instrument companies can also positively affect research results. “This assistance also promotes rigorous and reproducible research, especially when companies contribute to and share best practices with the user community,” Dr. Mische explained. “Finally, companies can offer affordable parts for older machines, especially models for which service contracts are no longer offered. While new equipment is preferred for pivotal experiments, older instruments may still be useful for training purposes and pilot studies.”

As Dr. Mische told ***IBO***, shared resource facilities have great potential to expand access to leading technologies and instrumentation, as well as accelerating scientific innovation. Through enhanced support and improved coordination, both institutes and instrument companies alike can help improve the access and usage of instrumentation and other needs at shared resource facilities.

As the FASEB addresses issues faced by basic, translational and clinical researchers through examining the effects of policy, advocacy and legislation in these areas, the FASEB has future plans to continue addressing challenges in the shared resource facility space, according to Dr. Mische.

ASHG 2017: New Single-cell, CRISPR and NGS Products Highlight Lab Technology's Progress

The 2017 American Society for Human Genetics Conference (ASHG) was held this year October 17–21 in Orlando, Florida. The conference was attended by 7,479 conferees, a 6.4% decrease from last year (see ***IBO*** 10/31/16). Exhibitor, guest and press registrants totaled 1,549. The theme of the conference this year was "Sharing Discoveries. Shaping our Future." The key trends presented at the conference were rather diverse as vendors demonstrated a number of key advances in single-cell analysis, CRISPR and structural variation elucidation—most with an eye towards advancing the routine use of genetics/genomics technologies in clinical settings. The keynote address was provided by Bill Gates of the Bill and Melinda Gates Foundation and Francis Collins, the Director of the NIH. Mr. Gates spoke at length about his Foundation's use of genetic/genomic technologies to improve health around the world, particularly in developing markets, and for driving down the rate of infant mortality around the world.

At the show, MissionBio announced a microfluidic system to analyze single-cell DNA capture and barcoding, the Tapestri platform. While most single-cell systems support transcriptome analysis, the Tapestri is able to barcode and capture genomic DNA for analysis of the heterogeneity of cell populations—key when monitoring cell populations in disease progression, treatment and post-treatment monitoring. The initial launch application of the Tapestri is an Acute Myeloid Lymphoma Assay, targeting 19 genes associated with this disease. MissionBio also announced it will be providing research grants to customers interested in developing custom panels for use on the Tapestri. The Tapestri platform is ready to ship. The cost of the platform is $79,500 for the system, with a cost per assay of $795.

BD released its Rhapsody Single-Cell RNA-Seq platform that allows for the analysis of targeted panels of transcripts at the single-cell level with less amplification bias than is typical in whole-transcriptome profiling. The system launched with preconfigured panels and the promise of additional panels containing genes of interest to be added in the coming months. BD also plans to combine protein analysis solutions (AbSeq) with the platform to analyze the correlation of transcription of targets and the correlated protein on the cellular level. BD stressed the reduction in costs for sequencing can be achieved through the use of targeted panels rather than through the broad sequencing of the whole transcriptome. The cost of the platform is competitive with other high-throughput platforms, according to the company. The platform is currently shipping, with the AbSeq protein detection system expected to be launched in the first half of 2018.

Agilent Technologies introduced an expansion of its SureGuide CRISPR library portfolio that allows for activation/inhibition (a/i) assays used in the location and identification of genes involved in a disease response. Agilent constructs its SureGuide a/i products using its SurePrint DNA synthesis platform, allowing for

extremely high accuracy of the constructs.

Bio-Rad Laboratories highlighted the success of its droplet digital PCR (ddPCR) platform across a range of new applications for single-cell analysis, including detection of mutations in iPSCs prior to treatment, ab initio detection of lung transplant rejection and detection of rare variants in expression profiles that lead to cancer growth. Bio-Rad also noted the quick adoption of its ddPCR platform for the rapid and sensitive validation of CRISPR constructs.

Like Bio-Rad, at ASHG, Thermo Fisher Scientific talked about the success of its products in specific applications; for example, enabling the detection of the genetic understanding of hearing loss, the use of its recently launched SeqStudio Genetic Analyzer with their XON Suite (in early release) for exonic deletion and how duplications detection is improving productivity in its release partner's clinical research laboratory.

Pacific Biosciences Chief Scientific Officer Dr. Jonas Korlach gave an update on the Pacific Biosciences (PacBio) roadmap, and discussed the advantages of the PacBio Sequel's impressive ability to annotate insertions and deletions in well-characterized genomes relative to Illumina, 10x Genomics, Oxford Nanopore and Bionano Genomics' technologies. Dr. Korlach highlighted that the PacBio sequencing affords the highest sensitivity for determining structural variation with the lowest false positive discovery rate. Dr. Korlach also recounted that PacBio sequencing is noted in 4–5 papers published in the scientific literature per day, noting applications such as Full-Length RNA Sequencing (i.e. Iso-Seq), lncRNA, amplification-free sequencing for the detection of rare variants in cancer, and the replacement of Sanger sequencing amongst other applications. In addition, he gave an update on PacBio's product developments that highlighted improved library prep, SMRT cell capacity and bioinformatics improvements.

In what might be a first for ASHG, Edico Genome was awarded a Guinness Book of World Records record on-site for the fastest secondary analysis of one thousand human genomes. They completed the task using data from the Children's Hospital of Philadelphia in 2 hours and 25 minutes. The feat highlighted its DRAGEN platform's use of cloud-based secondary analysis software that analyzes whole-genome samples in approximately 20 minutes. Edico Genome also announced a partnership with Fabric Genomics at the show for downstream analysis of DRAGEN-analyzed data using Fabric Genomics Opal Clinical variant interpretation platform.

ASHG 2018 will be held October 16–20 on the West Coast, in San Diego, California.

ASHG 2017 Spotlight: PerkinElmer Debuts New NGS Solution

ASHG 2017 served as the venue for the launch of PerkinElmer's latest NGS solution, the chemagic Prime platform for automated nucleic acid isolation and assay setup. The new platform is based on the company's chemagic 360 Nucleic Acid Purification (NAP) system and JANUS liquid handler.

About the modifications and/or additions that were made to the chemagic 360 and to the JANUS to create the chemagic Prime, Masoud Toloue, PhD, vice president and general manager of Applied Genomics, PerkinElmer, told ***IBO***, "We have created a joint housing, utilizing the attractive look of the JANUS G3 Workstation family, including the status features. With regard to customer convenience and ease of use, we developed new protocols which maximize the synergies between the chemagic 360 instrument and the JANUS workstation functions, in order to achieve the optimal performance of one integrated system, instead of simply combining two separate instruments."

The system is designed to provide specific advantages over similar platforms. "With the chemagic Prime instrument, we are now offering chemagic NAP performance in a fully automated way, as a single supplier solution for our customers," explained Dr. Toloue. He emphasized the single-vendor approach. "In our case, one supplier truly means one supplier of everything, from the MPVA Magnetic Beads used in the chemagic kits, to the instrument and the software, is developed and built by PerkinElmer."

Such integration can enhance application focus. "The whole chemagic Prime solution is focused on the application, and therefore optimized with regard to throughput and convenience without compromising the chemagic NAP quality," noted Dr. Toloue. This optimization includes flexibility. "In addition, the system design allows for the integration of further downstream operations, like PCR, or different assay setups," he said.

The platform is also indicative of PerkinElmer's strategy for the market for NGS solutions. As Dr. Toloue told ***IBO***,

“PerkinElmer is eliminating challenges associated with PCR and NGS sample prep by providing labs with complete, single-source solutions encompassing everything from isolation to analysis. The chemagic Prime instrument, developed by leveraging our core expertise in both nucleic acid isolation and liquid handling, is a scalable, and efficient walk-away solution for analysis of human samples.”

IBO New Funding Table

Selected New R&D and R&D-Related Funding Announcements			
Funder	**Recipient**	**Amount**	**Project**
Wellcome Trust	Primary Fund	£1 billion ($1.317 billion)	In an effort to accelerate science, research and public engagement, the UK organization has pledged in September to double the amount of expenditure that was spent on science each year over the past 10 years. Accprding to *Science|Business*, the Wellcome Trust will create a £903 million ($1.2 billion) per year primary fund through which research activities in science, innovation and culture will be able to thrive. The Trust is underwriting the primary fund for at least the next five years and will increase funds based on inflation year on year. The primary fund will cover funding for science grants and fellowships, Wellcome research centers, science programs in Asia and Africa, as well as the Sanger and Crick Institutes. A reserve fund has also been established for supporting other priorities.
University of Illinois; University of Chicago; Northwestern University	Illinois Innovation Network	$1.2 billion	A new initiative focusing on innovation, research and technology has been established by the three universities with the aim of accelerating Illinois' economy, the Illinois News Network reported earlier this month. Led by the University of Illinois, the premier project is the construction of the Discovery Partners Institute along the Chicago River, expected to house approximately 90 faculty members and 1,800 students, and foster the R&D of new technologies through collaborations between industry and academia. When the Institute is in operation, officials predict it will produce 10,000 student entrepreneurs every 5 years, as well as $500 million in new yearly R&D funding and up to $4 billion in VC investments. The University of Illinois will spearhead fundraising efforts, with hopes of receiving donations from both the private sector and the state.
Italian Ministry of Education, University and Research	Projects of National Interests	€400 million ($470.5 million)	In a surprise announcement in September, the Italian government will increase funding for basic research, *Science* magazine reported. To be spent over a 3-year period, the additional funds will more than quadruple the Research Projects of National Interests' (PRIN) regular annual funding, and is the largest increase in competitive funds in the last two decades. In 2015, the last funding round had a budget of €95 million ($111.7 million) for a three-year period. The largest portion of the increase, or €250 million ($294.0 million) will be allocated to PRIN from unused reserves at the Italian Institute of Technology (IIT) in Genoa, with the surplus stemming from an unrealized plan to expand the IIT in 2014.
South Korean Government	Open Innovation Project	KRW 500 billion ($450 million); KRW 1 trillion ($900 million)	After finalizing the country's biotechnology development plan for 2017–2026, the South Korean government announced in late September that it will establish and fund a KRW 500 billion ($450 million) collaborative project between industry, research institutes, hospitals and academia to increase the number of new drug candidates from 100 to 185 by 2026, as well as to help biotech companies create at least 5 new blockbuster drugs, according to *Business Korea*. The government also announced that it will raise a “mega fund” of at least KRW 1 trillion ($900 million) for new drug development through a collaboration between financial institutions, pharmaceutical companies and foreign investors that will provide R&D and financial support to startup and technology transfer businesses. The mega fund will cover funds for the stages before and after preclinical development. South Korea also indicated plans to lift biotechnology exports from $522 million to $2.732 billion between 2015 and 2025.
Australian Government	Australian Brain Cancer Mission	AUD 100 million ($78.0 million)	According to ABC Australia, the Australian Brain Cancer Mission, established this month, is made up of a AUD 50 million ($38.9 million) investment from the federal government, AUD 20 million ($15.6 million) from the Cure Brain Cancer Foundation, AUD 10 million ($7.8 million) from the Minderoo Foundation and AUD 20 million from a TBA philanthropic group. Priorities for the Mission include: investments in more clinical trials, new discovery work and international collaborations; the establishment of a new Australian arm of GBM Agile (an international adaptive trial platform for adults with a type of brain cancer); funding for clinical trial centers at the Australian and New Zealand Children's Hematology Oncology Group, as well as the ZERO Children's Cancer initiative; and funding for new grant projects, scholarships and fellowships, as well as collaborations with the pharmaceutical industry for drug development.
Nestle	Nestle Food Safety Institute	₹7 crore ($1.052 million)	Inaugurated in Manesar, Haryana, in September, the Nestle Food Safety Institute (NFSI) has been established to help create standards in food safety and quality in India, a monumental task due to the diverse food ecosystem in the country. *BusinessLine* reported that the NFSI is also expected to help develop and improve skills of various food companies that have both small and large operations. The NFSI addresses a growing demand for safe and high quality food in the country, and will collaborate in R&D through expertise from 40 research centers around the world. The new center is also planning to provide training programs on food safety management, testing methods and regulatory standards for the benefit and support of smaller food companies and technical staff in regulatory bodies. Nestle India does not have control over the NFSI, as it is under the Nestle Research Center in Lausanne, Switzerland.

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Danaher Dives into Informatics

Guildford, UK 10/31/17—Danaher has acquired IDBS, a supplier of enterprise scientific informatics platforms, for an undisclosed amount. IDBS offerings include the IDBS E-WorkBook Cloud. IDBS joins Danaher Life Sciences. "IDBS' informatics solutions integrate insights derived using scientific instruments from various vendors and from many different disciplines, enabling better and faster scientific and business decisions ultimately affording patients faster and better therapies." commented Danaher Executive Vice President Rainer Blair. "IDBS opens a new generation of vendor agnostic information-based digital services for Danaher and makes the digital lab a reality." IDBS Founder and CEO Neil Kipling stated, "By linking the IDBS knowledge management platform with their comprehensive instrument coverage it will create a 'data spine' that connects instruments, creating opportunities for new information-based services and the realization of the digital lab of the future." IDBS' platform technologies are used by over 200 pharmaceutical companies, health care providers, universities and high-tech companies.

According to a spokesperson for IDBS, the company has 250 employees. Citing sources familiar with the deal, Bloomberg reported a purchase price of about $100 million. With the purchase, Danaher enters the lab informatics market, specifically the ELN market, joining other analytical instrument makers, such as Agilent Technologies and PerkinElmer. The market's largest provider is privately held LabWare.

The purchase provides Danaher Life Sciences with informatics expertise and platforms. As with its purchases of Leica Microsystems and SCIEX and their impact on the confocal microscopy and MS markets, respectively, Danaher's latest purchase can be expected to increase market competition both for lab information management for research labs and also for its instrument offerings, as it can now provide more integrated solutions for lab data management as well as cloud-enabled options.

Hach Adds to Its Process-Analysis Portfolio

Loveland, CO 10/23/17—Water analysis firm Hach, a Danaher company, has acquired Belgium-based AppliTek for an undisclosed amount. AppliTek designs and manufactures wet chemical and biological online analyzers. Parameters measured include nutrients, hardness, alkalinity, toxicity, ATP, TOC and others. "We are excited to add this respected leader in wet chemistry analysis to the Hach family," commented Hach President Kevin Klau. "AppliTek analyzers complement our existing portfolio and provide us a scalable platform from which we can drive future growth."

*Regarding the purchase, Barry Lyon, vice president of Marketing for Hach, told **IBO**, "AppliTek is well known for leveraging wet chemistry and application expertise in both industrial and municipal water treatment to help customers monitor their water and make process decisions. Many customers know AppliTek for the EnviroLyzer Series, which has monitoring applications in waste water, boiler feed water, surface water and drinking water." The EnviroLyzer provides online, colorimeter-based measurements of a single parameter. "AppliTek is also well known for system integration division designs—it engineers and constructs online monitoring systems, from liquid analysis systems to complex gas monitoring shelters often utilized in heavy industrial sites."*

AppliTek's instruments employ potentiometry, luminometry, IR spectroscopy, Raman spectroscopy and respirometry for process analysis. AppliTek is expected to grow sales 200%–300% this year, according to its website.

UK Chromatography Supplier Sold

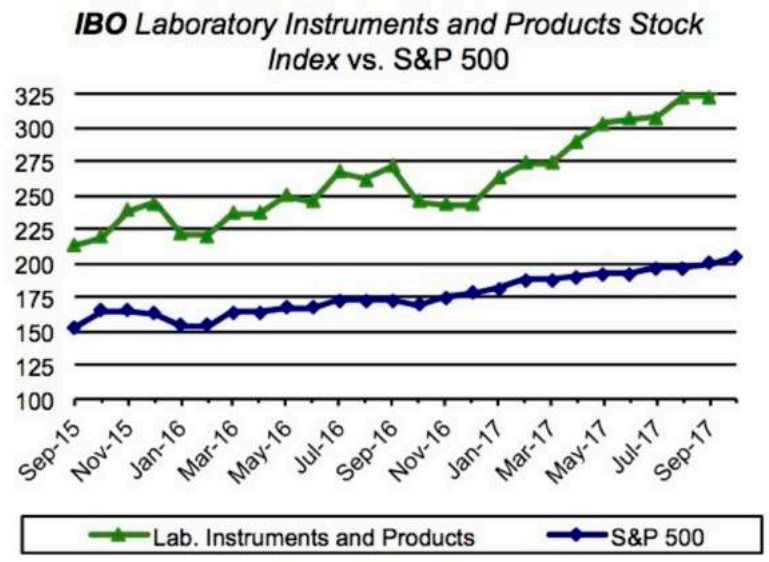
London, UK 10/19/17; London, UK 10/19/17—Limerston Capital Partners has acquired UK-based Crawford Scientific from Maven VCT for an undisclosed amount. Crawford Scientific supplies chromatography products, as well as analytical services through its Hall Analytical Laboratories subsidiary. "I am delighted we have been able to acquire Crawford Scientific, which provides an excellent platform to enter the attractive chromatography testing and analytical services niche," commented Joao Rosa, founding partner of Limerston Capital. Maven reported a 4.7x return on its initial investment in a little over three years. During this period, Crawford Scientific's sales and staff doubled, and profitability tripled. Crawford's existing senior management team remains in place.

Founded in 1995, Crawford Scientific serves as distributor of GC, LC and SPE products. The company's annual sales total over £10 million ($13 million at £0.78 = $1), according to Maven VCT's website. Customers include pharmaceutical companies. This is Limerston's first investment in the lab product market.

Strong Start for IBO Indexes into Q3

The US economy remained sturdy this month even after the disastrous string of hurricanes, which brought millions of dollars in damage to the nation. As such, the US GDP grew at an estimated 3.0% in the third quarter, surpassing analysts' expectations of 2.5%. Other parts of the US economy also showed signs of improvement as the unemployment rate fell to 4.2%, the lowest since 2001. Additionally, consumer spending also improved, increasing a robust 3.3%.

The Dow Jones Industrial Average (DJIA) rose 4.3% to 23,377.24 in October, marking a seventh consecutive monthly increase after its slight dip in March. Year to date, the Index has risen 18.3%. Following the DJIA in percentage growth was the NASDAQ Composite, advancing 3.6% to 6,727.67. Year to date, the Index is up 25.0%. The S&P 500 experienced the slowest growth amongst the three indexes, climbing just 2.2% to close at 2,575.26 for the month.



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Laboratory Instrumentation Stock Index

For October, the *Laboratory Instrumentation Index* grew steadily, increasing 4.8% to 338.35. Year to date, the *Index* is up a strong 39.2%. Within the *Index*, **Fluidigm**'s share price grew the most, advancing 15.1% to close at $5.80 for the month. Conversely, **Nanostring Technologies** shares sunk 38.4% to end the month at $9.96, due to lower-than-expected revenues. On October 11, Nanostring reported its third quarter preliminary earnings. As such, Product and Service sales came short of the company's projection, amounting to approximately $16.9 million versus the expected $19.5–$21.5 million (see ***IBO*** 10/15/17). Following the earnings report, on October 12, Robert W. Baird, an asset management fund, lowered the stock price target from $23.00 to $19.00.

Agilent Technologies shares grew a healthy 6.0% to $68.03 for the month. On October 20, Robert W. Baird reiterated its "buy" rating, along with a price target of $70.00 for the stock. Similarly, **Bio-Techne**'s share price advanced 8.4% to $131.02 for the month due to strong revenue (see Bottom Line) and earnings. The company's fiscal year 2018 first quarter results were reported on October 30, as it recorded an adjusted EPS of $0.90, an increase of 7.1%.

On October 24, **Illumina** reported its third quarter earnings, for which net income totaled $163 million and adjusted

EPS equaled $1.11, an increase of 14%. Finishing at $205.19, the company's share price rose 3.0% for the month and has risen 60.3% year to date. On October 23, Deutsche Bank upgraded the stock's rating from "hold" to "buy".

Harvard Bioscience's share price dipped 10.7% for the month, closing at $3.35. The company's third quarter adjusted EPS matched analysts' expectations of $0.03 for flat year-over-year growth. However, Harvard Bioscience expects fourth quarter adjusted EPS to be approximately $0.05–$0.06.

On October 30, **Luminex** reported its third quarter results, showing an adjusted EPS gain of $0.25. Net income for the company totaled $17.6 million, a significant increase over last year's $2.7 million due to an $11.1 million income tax benefit. For the month, Luminex's share price advanced 5% to close at $21.35.

Thermo Fisher Scientific reported its third quarter earnings on October 26, delivering an adjusted EPS of $2.31, a 13.8% increase. The company's share price climbed 2.4% to $193.83 for the month and has increased 37.4% year to date. Thermo Fisher upgraded its full-year adjusted EPS guidance due to the strong operational performance of the recently acquired company Patheon (see ***IBO*** 5/15/17). The updated full-year adjusted EPS is expected to be around $9.29–$9.38, versus the previously projected $9.15–$9.28, signifying 12%–13% earnings growth.

On October 24, **Waters** reported strong third quarter earnings as adjusted EPS rose 13% to $1.77, beating analysts' estimates of $1.74. As a result, the company's share price increased 9.2% to $196.05 for the month.

Company	Date Rep.	Fiscal Quarter	2017 Adj. EPS	Analyst Consensus	Vs. Estimate		YOY Growth	2016 Adj. EPS
Laboratory Instruments and Products Stock Index								
HBIO	26-Oct	Q3	$0.03	$0.03	⇨	$0.00	0%	$0.03
ILMN	24-Oct	Q3	$1.11	$0.98	⇧	$0.13	14%	$0.97
LMNX	30-Oct	Q3	$0.25	$0.08	⇧	$0.17	317%	$0.06
TECH	30-Oct	Q1	$0.90	$0.89	⇧	$0.01	7%	$0.84
TMO	26-Oct	Q3	$2.31	$2.24	⇧	$0.07	14%	$2.03
WAT	24-Oct	Q3	$1.77	$1.74	⇧	$0.03	13%	$1.57
Diversified Laboratory Stock Index								
DHR	19-Oct	Q3	$1.00	$0.95	⇧	$0.05	15%	$0.87
GLW	24-Oct	Q3	$0.43	$0.41	⇧	$0.02	2%	$0.42
HON	20-Oct	Q3	$1.75	$1.74	⇧	$0.01	5%	$1.67
ITW	23-Oct	Q3	$1.71	$1.65	⇧	$0.06	14%	$1.50
ROP	30-Oct	Q3	$2.36	$2.30	⇧	$0.06	20%	$1.96
XYL	31-Oct	Q3	$0.65	$0.63	⇧	$0.02	20%	$0.54

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Diversified Instrumentation Stock Index

The *Diversified Instrumentation Index* advanced 4.5% to 260.61 in October, with all companies in the *Index* ending in positive territory. Year to date, the *Index* has advanced 26.8%. **Danaher**'s share price grew the most at 7.6%, closing out the month at $92.27. Conversely, **Honeywell** gained the least, as its share price rose only 1.7% to close at $144.16.

AMETEK received a boosted price target on October 13, with Jefferies Group setting a "buy" rating along with a price target of $77. Since the rating's update, the company's share price has gained $0.30, or around half a percent. Similarly, **Honeywell** also received a boosted price target as Credit Suisse set a target of $150.00 on October 23, an increase over the previous price of $141.00. However, since the price target change, the stock price has fallen 1.3%.

Corning's shares increased 4.7% to close at $31.31 for the month, supported by a $29.50 price target from Jefferies Group on October 6. Year to date, the company's share price has increased 29.0%.

On October 19, **Danaher** reported net earnings of $572.1 million, along with an adjusted EPS of $1.00. Year over year, the company's adjusted EPS rose by 15%. For the fourth quarter, Danaher expects adjusted EPS to be $1.12–$1.16, amounting to a full-year expected adjusted EPS of $3.96–$4.00. In October, the company's share price advanced 7.6% to $92.27, bolstered by Credit Suisse's price target upgrade from $93.00 to $96.00.

Illinois Tool Works (**ITW**) was first given a "buy" rating by Citigroup on October 9, followed by another on October 16 from Wells Fargo. The former gave a price target of $171.00, while the latter gave a price target of $170.00, both an increase from $162.00. On October 23, the company reported an adjusted EPS of $1.71, an increase of 14%, beating analysts' expectations of $1.65. For the fourth quarter, ITW expects its GAAP EPS to be around $1.55–$1.65 and its full-year GAAP EPS to be between $6.62 and $6.72. The company's share price advanced 5.8% for the month, closing at $156.52.

Roper Technologies' shares increased 6.0% to $258.17 in October, strengthened in part by a "buy" rating from Cowen and Company that was issued on October 12. Roper expects its fourth quarter adjusted EPS to be approximately $2.56–$2.62. As for its full-year adjusted EPS guidance, the company projects $9.27–$9.33, versus its previous guidance of $9.12–$9.30.

Xylem reported third quarter adjusted net income of $119 million, equaling $0.65 adjusted EPS, an increase of 20%. The company's adjusted EPS beat analysts' expectations of $0.63 by $0.02. For the full year, Xylem projected adjusted EPS to be $2.39–$2.41.

International Stock Index

Asia Pacific equity markets traded mostly positively, with average growth of 4.6% for the month. The APAC Indexes' largest growth contributor was Japan's Nikkei 225, increasing 8.1% to 22,011.61 in October. Conversely, Malaysia's KLCI fell 0.4% to 1,747.92 and was the only APAC index to decrease.

GL Sciences's shares vaulted 18.6% to ¥2,019.00 ($17.77 at ¥113 = $1) this month. **Precision System Science** and **Hitachi High-Technologies**' shares both increased double digits as well, growing 15.4% and 15.6%, respectively. **JEOL**, along with Hong Kong's **Techcomp,** both grew low single digits, at 4.5% and 2.8%, respectively. For the year, GL Sciences' share price has increased the most among Asia Pacific companies in the ***IBO*** Stock Table, advancing 128.1%. Hitachi High-Technologies, however, has experienced a flat year-to-date increase, the lowest among Asia Pacific companies in the ***IBO*** Stock Table.

European equity markets traded modestly higher, as average Index growth was 1.5% for the month. Germany's XETRA DAX and France's CAC rose the most, advancing 3.1% and 3.3%, respectively.

Among European shares in the ***IBO*** Stock Table, the top performer was Sweden's **Biotage**, which soared 22.6% to close at SEK 74.50 ($8.90 at SEK 8.37 = $1). Year to date, **Biotage**'s shares have grown 62.3%. Following closely is Germany's **Datacolor**, as its share price also grew double digits, up 18.0%, closing the month at CHF 899.50 ($899.50 at CHF 1 = $1). **Tecan**'s shares grew modestly, up 5.3% to CHF 211.00 ($211.00). In contrast, **Merck KGaA** and **Sartorius** shares both ended the month in negative territory, sliding 2.3% and 1.9%, respectively.

The UK's FTSE 100 advanced 1.6% to 7,493.08 for the month. Similarly, overall, UK stocks in the ***IBO*** Stock Table finished in positive territory, with the best performing stock, **Horizon Discovery**, growing 12.8% to £2.56 ($3.40 at £0.75 = $1). Conversely, **Scientific Digital Imaging**'s shares fell the most, decreasing 7.0% to £0.21 ($0.28).

Halma and **Spectris**' shares both grew steadily for the month, increasing 5.5% to £11.82 ($15.70) and 6.2% to £25.60 ($34.01), respectively. But **Oxford Instruments**' shares fell slightly, down 2.0% to £9.51 ($12.63). With **Abcam** shares also down, falling 2.5%, London shares in the ***IBO*** Stock Table were split half and half between positive and negative territory for October.

Company: Exchange	Market Value (US M)	52 Week Range Low ($)	High ($)	Price 10/31/17	Change 1 Month	Change YTD	P/E (ttm)	EPS (ttm)
Laboratory Instruments and Products								
Agilent Technologies: n	$20,865	42.92	61.84	$68.03	6.0%	49.3%	34	1.99
Becton, Dickinson and Company: n	$42,691	161.29	206.63	$208.67	6.5%	26.0%	61	3.44
Bio-Rad Laboratories: n	$6,647	143.39	239.91	$219.79	-1.1%	20.6%	440	0.50
Bio-Techne: o	$4,533	95.68	117.42	$131.02	8.4%	27.4%	70	1.86
Bruker: o	$4,775	19.59	27.85	$31.40	5.5%	48.3%	31	1.00
Enzo Biochem: n	$485	4.88	9.68	$9.85	-5.8%	41.9%	14	0.71
Fluidigm: o	$147	4.31	11.05	$5.80	15.1%	-20.3%	NM	-2.46
Harvard Bioscience: o	$130	2.25	3.90	$3.35	-10.7%	9.8%	NM	-0.13
Illumina: o	$29,282	119.37	189.48	$205.19	3.0%	60.3%	41	4.99
Kewaunee Scientific: o	$81	16.38	27.60	$28.50	-3.4%	16.6%	18	1.60
Luminex: o	$874	17.64	23.75	$21.35	5.0%	5.5%	67	0.32
Mettler-Toledo: n	$16,651	343.61	582.20	$682.63	9.0%	63.1%	93	7.32
MTS Systems: o	$1,021	41.53	59.00	$52.05	-2.6%	-8.2%	41	1.27
NanoString Technologies: o	$349	11.89	23.45	$9.96	-38.4%	-55.3%	NM	-2.11
Pacific Biosciences: o	$488	3.46	10.40	$4.23	-19.4%	11.3%	NM	-0.91
PerkinElmer: n	$7,602	45.35	63.03	$72.32	4.8%	38.7%	22	3.31
QIAGEN: o	$7,399	20.73	33.06	$33.86	7.5%	20.8%	106	0.32
Thermo Fisher Scientific: n	$74,564	139.07	173.64	$193.83	2.4%	37.4%	34	5.74
VWR: o	$4,371	24.42	37.25	$33.11	0.0%	32.3%	31	1.08
Waters: n	$14,496	131.35	179.07	$196.05	9.2%	45.9%	30	6.63
Diversified Laboratory								
AMETEK: n	$15,253	43.28	61.37	$67.49	2.2%	38.9%	30	2.28
Corning: o	$27,996	18.88	29.72	$31.31	4.7%	29.0%	14	2.31
Danaher: n	$60,528	73.42	88.01	$92.27	7.6%	18.5%	27	3.38
Honeywell	$108,185	105.25	135.00	$144.16	1.7%	24.4%	22	6.60
Illinois Tool Works: n	$51,642	98.32	142.82	$156.52	5.8%	27.8%	25	6.18
Roper Technologies: n	$25,097	159.28	228.21	$258.17	6.0%	41.0%	39	6.68
Teledyne Technologies: n	$5,747	92.52	137.00	$169.96	6.8%	38.2%	31	5.43
Xylem: n	$11,317	42.52	54.99	$66.53	6.2%	34.3%	43	1.55
Laboratory Instruments and Products				**338.35**	**4.8%**	**39.2%**	**71**	
Diversified Laboratory				**260.61**	**4.5%**	**26.8%**	**29**	
Dow Jones Industrial Average				23,377.24	4.3%	18.3%		
S&P 500				2,575.26	2.2%	15.0%		
NASDAQ Composite				6,727.67	3.6%	25.0%		
Region Company	Market Value (Local M)	52 Week Range Low (L)	High (L)	Price 10/31/17	Change 1 Month	Change YTD	P/E (ttm)	EPS (ttm)
Pacific Shares								
GL Sciences: t	¥17,076	557	1,494	¥2,019	18.6%	128.1%	14	¥144.19
Hitachi High-Technologies: t	¥540,625	3,360	5,040	¥4,715	15.6%	0.0%	19	¥245.97
HORIBA: t	¥286,671	4,305	7,440	¥6,710	5.5%	24.0%	18	¥375.69
JEOL: t	¥50,714	356	648	¥598	4.5%	17.3%	83	¥7.21
Precision System Science: os	¥13,077	334	1,011	¥675	15.4%	65.8%	NA	-¥71.44
Shimadzu: t	¥598,358	1,394	2,254	¥2,348	6.0%	26.1%	27	¥87.56
Techcomp: hk	HKD 521	1.07	3.21	HKD 1.86	2.8%	44.2%	24	¥0.01
European Shares (London)								
Abcam: l	£2,168	7.14	10.34	£9.95	-2.5%	29.7%	48	£0.21
Halma: l	£4,144	8.79	11.82	£11.82	5.5%	31.7%	35	£0.34
Horizon Discovery: l	£231	1.05	2.71	£2.56	12.8%	77.8%	NA	-£0.12
Oxford Instruments: l	£601	6.10	11.39	£9.51	-2.0%	29.8%	NA	-£0.44
Scientific Digital Imaging: l	£22	0.13	0.31	£0.21	-7.0%	15.6%	18	£0.01
Spectris: l	£2,757	18.40	28.69	£25.60	6.2%	10.7%	96	£0.27
European Shares (Other)								
Biotage: st	SEK 3,818	33.90	67.50	SEK 74.50	22.6%	62.3%	41	SEK 1.83
Datacolor: s	CHF 124	538.00	800.00	CHF 899.50	18.0%	38.4%	22	CHF 41.39
Merck KGaA: g	€ 11,946	88.20	115.20	€ 92.26	-2.3%	-6.9%	25	€ 3.68
Sartorius: g	€ 6,028	65.01	90.12	€ 76.71	-1.9%	5.4%	45	€ 1.70
Tecan: s	CHF 2,159	148.80	187.30	CHF 211.00	5.3%	32.8%	44	CHF 4.84

The ***IBO*** *Stock Indexes* are weighted by marked capitalization. The *Indexes*' averages for the financial ratios presented are also weighted statistically to reflect the relative sizes of the constituent companies. *Laboratory Instruments and Products Index*: 12/30/11 = 100. *Diversified Laboratory Index*: 12/30/11 = 100. Exchanges: n = NYSE; o = NASDAQ; t = Tokyo; hk = Hong Kong; l = London; g = Germany; s = Switzerland; st = Sweden; no = Nordic Market; os = Osaka Securities. N/A = not available; NM = not meaningful.

Fourier Transform Near Infrared Spectroscopy

For practical reasons relating to the illumination sources and detectors, optical spectrometers cover some fixed range of wavelengths of light. The band of the electromagnetic spectrum with wavelengths just longer than the longest red wavelengths visible to the human eye is known as the near infrared (NIR). Although the exact borders of the NIR band are somewhat arbitrary, wavelengths from about 750 nm to 2500 nm are typically included. The NIR band separates visible light from the mid-infrared. While the mid-infrared is associated with many of the fundamental rotational and vibratory modes of molecules, the NIR region is sensitive to overtones of these fundamental modes and thus can be used for spectroscopy to identify molecules in a sample. One advantage of NIR over the mid-infrared is that NIR can generally penetrate further into a sample, making bulk measurements of materials more feasible

The general configuration of an NIR spectrometer is similar to many other forms of spectroscopy, with a light source, a place for the light to interact with the sample and a detector that analyzes the transmitted or reflected radiation. In Fourier Transform–NIR (FT-NIR), many different infrared sources are used, from simple incandescent lights to filtered laser sources. The common theme is that the sources provide multiple wavelengths of illumination. By modulating the mix of wavelengths impinging on the sample, the FT method can be used to determine the response of the sample at each individual wavelength, thus producing a spectrum. The use of the transform provides advantages in speed and signal-to-noise over other methods that may use dispersive filters or other methods to build up a spectrum. For detection, instruments commonly use a combination of two or more materials (e.g., both silicon and InGaAs) to provide the best response across the entire NIR range.

The majority of applications for NIR are in QC and inspection of incoming materials. While FT-NIR instruments generally have better performance specifications than lower-cost instruments, making them more suitable for research applications, the QC and inspection applications still predominate. The pharmaceutical industry is the largest individual source of demand for FT-NIR, with applications for the technique throughout the research and production suites. Systems with fiber optic probes are used to verify incoming materials, at-line and in-line systems are used to check the materials near or in the production line, while finished pharmaceutical products are also checked for QC. The next most common usage for FT-NIR is in the agriculture and food industry. Although lower-cost dispersive systems are very common in the food industry, FT-NIR systems have also gained popularity for similar applications in gauging the water, protein and fat content of food products. Polymers and plastic are also suitable for analysis by FT-NIR. Other sample types include chemicals, personal care products, paper and pulp, and other materials.

Three strong competitors dominate the market for FT-NIR. The market leader is Bruker, which offers several platforms for FT-NIR in benchtop, at-line and in-line configurations. PerkinElmer and Thermo Fisher Scientific round out the top three competitors in the market. Other competitors in FT-NIR include ABB, ARCoptix BÜCHI, AIT and Lumex . The total market demand for laboratory FT-NIR was about $125 million in 2016.

FT-NIR at a glance:

Leading FT-NIR Vendors

- Bruker
- PerkinElmer
- Thermo Fisher Scientific

Largest Markets

- Pharmaceuticals
- Agriculture and Food
- Polymers and Plastics

FT-NIR Instrument Cost

- $12,000–$80,000

October 15 Issue: JEOL

In the October 15, 2017 issue of ***IBO***, in the article Next Generation Lithium Ion Batteries: Analytical Techniques Pave the Way, the quotes attributed to Micheal Frey, PhD, of JEOL should have been attributed to Natasha Erdman, PhD, and vice versa. ***IBO*** regrets the error.

Nanotechnology

The Organization for Economic Cooperation and Development (OECD) released new standards this month for determining the toxicity and environmental impacts of nanoparticles. Released from data collected by the OECD's materials testing program, which has been going on for approximately a decade, the guidelines detail two inhalation toxicity studies that can be conducted on rodents over either 28 days or 90 days, as well as a study examining methods to measure the dispersal of nanoparticles in the environment. As the guidelines have been accepted by all OECD member countries, researchers can conduct a test in an OECD country and be able to use the data in other OECD jurisdictions around the world, reducing costs and resources that are usually required to meet regulatory requirements.

Simultaneously in Europe, the European Commission recently released a proposal on adapting REACH regulations so that they are more specific in regards to nanomaterials, and are in the midst of a consultation to determine the exact definition of a "nanoform" in the context of REACH guidelines.

Source: *Chemistry World*

R&D

Last week, the Human Cell Atlas initiative was officially launched. Researchers from all over the world are participating in the program, including scientists from organizations and institutes such as the Wellcome Trust Sanger Institute, RIKEN, the Karolinska Institute, the Broad Institute and Harvard University. The use of new technologies is key for the initiative, with advances in RNA sequencing and protein structure analysis of a cell to trace its lineage through markers and mutations playing a central role. The purpose of establishing the cell atlas is to provide researchers with a reference to compare healthy and diseased cells, as well as to support regenerative medicine studies, which involves the regeneration of human cells, tissues or organs. The cell atlas will also result in diagnostic tests, such as complete blood count tests, being more illuminating and informative, as cell types would be identified more accurately; this could result in quicker diagnoses of blood cancers, autoimmunity diseases and infections. Already, new cell types have been found in the brain, gut, retina and immune system, which has provided novel insight into the formation and dynamics of tumors.

Challenges with the initiative include narrowing the scope of the project. First, the project will focus on tissues instead of entire organs, while organs will be researched in later phases. Ultimately, the atlas aims to provide a detailed reference of molecules, cells, tissues, organs and systems in the human body. Obtaining samples through standardized procedures, where consent is provided and the sample is properly filed and tracked, are also extremely important. Members of the initiative also emphasize the necessity of the atlas being an open source initiative, including hosting data and analysis in multiple public clouds (as of now, clouds such as Microsoft, Amazon and Google), and having publications that publicize the data to help establish standardized methods and approaches to the analysis.

Source: *Nature*

Energy

Along with decreasing oil demand, gasoline usage around the world is expected to peak within the next 10 years, resulting in the world's largest energy firms moving to natural gas and chemicals. Oil consumption is forecast to grow until 2035 in the form of the petrochemical industry, and this is predicted to offset the declines in some transport fuels.

While gasoline usage is expected to peak within the next decade, the tipping point for oil demand is a matter of debate within the oil industry. Experts predict that by 2035, although oil demand may not have peaked, it will be minimal compared to the demand over the past two decades. By that time, oil demand is expected to plateau in Europe, the US, China and Japan, with only emerging markets making up the vast majority of oil consumption, such as India and other parts of Asia, the Middle East, Latin America and Africa responsible for the bulk of oil usage.

However, while fuel oil and gasoline markets will peak and plateau, consumption of petrochemicals such as diesel and naphtha (used in the petrochemical industry as feedstock) will rise. The petrochemical industry is a saving grace for the oil industry, as this segment is forecast to increase oil consumption feedstock by 50% between 2017 and 2035.

Source: *Bloomberg*

Russia

Russia: The Russian government is planning to downsize its 5-100 program, which was designed to create five world class universities. The Ministry of Education and Science will reduce the number of universities funded by the program from 21 to 6 in order to meet the program's objectives. Scheduled to run from 2013 to 2020, the program's funds stand at $524 million compared to the more than $873 million that has already been spent.

An additional $20.2 billion will be provided for 2018–2020. The National Research University Higher School of Economics, the Moscow Institute of Physics and Technology, the Novosibirsk State University, and the St. Petersburg National Research University of Information Technologies, Mechanics and Optics are among the universities that will continue to participate in the program. Researchers contend that the reputations of universities that lose the program's support will be harmed, and that the country's size dictates a higher number of leading universities.

Source: *University World News*

China

Earlier this month, the Chinese Ministry of Science and Technology released a report detailing a speedy increase in scientific and technological innovation in the country. According to the report, in 2015, academic R&D funding was approximately CNY 100 billion ($15.0 billion), 2.6 times more than in 2006. Public and private R&D funding to higher education institutes in 2015 was over CNY 35 billion ($5.3 billion).

Compared to 2006, full-time R&D personnel in higher education institutions in China has increased 46.7%, reaching 355,000 in 2015. The number of patents also increased from 2006, with 8.2 times more patents licensed in 2015, totaling 136,000, which includes 57,000 innovation patents.
Source: *Xinhua*

South Africa

Last week, the federal National Research Foundation (NRF) announced that in order to cut costs, a leading grant program in the country will have its budget decreased. The incentive funding-based grant program provides money to researchers who are voluntarily rated, with more funds going to researchers with higher ratings. Although funding will be cut across all rating types, top-rated researchers, or A-rated researchers, will be hit the hardest, with some losing up to 90% of their grant money. The NRF announced that A-rated researchers' grants will decline 50%, going from ZAR 100,000 ($7,280) per year over a five-year period to a single payment of ZAR 50,000 ($3,640) in the first year of their rating. Similarly, emerging young researchers, or Y-rated researchers, will receive ZAR 100,000 ($7,280) from the NRF over a two-year period, instead of the original payment of ZAR 40,000 ($2,912) each year over a five-year period. Beginning in 2019, only P-rated researchers, young researchers under the age of 35, will receive an annual payment of ZAR 50,000 ($3,640); researchers with other ratings will receive a single payment of ZAR 30,000 ($2,184), provided they maintain their rating.

Source: *Nature*

Liquid Chromatography

Company News

Specialty resin provider **Purolite Life Sciences** announced in June a collaboration with **ChromaTan**, a supplier of single-use chromatography solutions, to develop and commercialize a custom-designed, novel Protein A resin bead specifically to address the needs of continuous manufacturing.

In September, **Phenomenex** initiated direct sales and support in Switzerland. The decision was a mutual agreement with its local distributor, **Brechbühler**.

PharmaFluidics, a maker of nano-LC cartridges, appointed Fasha Mahjooras as an independent director. He served as president of **Phenomenex** until July 2017 and currently serves as chairman of **Farrona**, a holdings company.

In October, **Takeda Pharmaceutical** announced the launch of **Chromajean**, the second biotech company to originate as part of its Entrepreneurship Venture Program initiative. Chromajean offers services contributing to preclinical and early development chemistry efforts. This includes an enhanced chromatography process using a unique algorithm that allows all scientists to optimize analytical and purification methods without having to depend on individual capability and experience.

GE Healthcare opened in October its first printing lab, the Innovative Design and Advanced Manufacturing Technology Center for Europe, in Uppsala, Sweden. The Center combines advanced manufacturing technology and collaborative robots with traditional machining equipment. GE is working with biotech firm **Amgen** to test the performance of a custom-designed, 3D-printed chromatography column for biopharmaceutical production.

In October, **ChromaCon** announced the establishment of a training center for automated and continuous chromatography at the **Chinese National Engineering Research Center for Protein Drugs** in Beijing, China. The training center will be operated by its distribution partners **H&E** and Center staff.

Product Introductions

In August, MS company **Advion** released easy-to-use UHPLC and HPLC systems. The systems work in synergy with the company's compact mass expression CMS systems.

Showa Denko introduced in October five new Shodex analytical HPLC columns: the GPC HK-401, GPC HK-405 and GPC HK-HFIP4041 for GPC and SEC; the OHpak LB-805 packed columns for gel filtration chromatography; and the

IEC SP-FT 4A packed column for ion exchange chromatography. The columns feature faster analysis times and higher sensitivity.

In September, **Shimadzu** launched the i-Series Plus integrated HPLC. It features automated sample pretreatment, including processes to dilute samples and add reagents, as well as a mode to inhibit orphan data (measurements performed without leaving records on the instrument). This is the fifth product in the i-Series product line.

ChromaCon launched in September the Contrichrom Discovery, a highly automated multistep batch FLC system for tagged proteins and antibodies. It combines full single-column batch functionality and automated multistep batch purification. A high-throughput model can purify up to 18 consecutive samples per sequencing unattended.

Shimadzu debuted in September the Nexera FV UHPLC to improve the operational efficiency of tests to evaluate the dissolution of contained components in the development and QC of pharmaceutical dosage forms. It features automated sampling, automated calculation of dissolution rate and automated output of test results.

Evosep debuted in September the Evosep One, a novel separation solution designed for fast and robust separation of omics samples in large clinical cohort studies (primarily proteomics and metabolomics). The design target is the separation of omics samples at 1 µL/min into an MS, with 24/7 operation at 200 samples per day.

Phenomenex released in October the SecurityCAP, a mobile phase and solvent waste–safety system for HPLC and UHPLC systems.

Phenomenex introduced in October the Kinetex 3.5 µm PAH HPLC/UHPLC column, which combines unique selectivity for PAHs with Core Shell Technology.

In October, **Postnova Analytics** debuted the EAF2000 for simultaneous electric and asymmetrical flow field-flow fractionation. It enables separations by particle size and particle charge based on electrophoretic mobility. It is available with a wide range of add-on modules, including RI, MALS and DLS detectors.

Sales/Orders of Note

In September, **ChromaTan** was awarded a two-year, $2.5 million contract from the **FDA** to develop an integrated, continuous downstream purification platform for the production of monoclonal antibodies.

Shimadzu announced in September the sale of over 10,000 units of its i-Series U/HPLC systems.

Life Science Consumables

General Life Science Consumables

Company Announcements

Neogen appointed in July John Adent as CEO. He most recently served as CEO of Animal Health International. Former CEO James Herbert will remain as chairman.

Streck announced in September an exclusive distribution agreement with **ORGENTEC SASU** for France.

In October, **Vector Laboratories** named **MJSBioLynx** as its exclusive Canadian distributor.

Meridian Bioscience announced in October that it expects fiscal 2017 revenues to increase 2% to $200.5 million. Fourth quarter sales are forecast to rise 5%, with 14% growth for the Life Science segment and 3% growth for the Diagnostic segment. Fiscal 2018 revenues are expected to increase 3%–6% to $207–$212 million, including mid- to high single digit growth for the **Bioline** molecular component business. In July and October, the FDA issued the company warning letters in connection with its **Magellan Diagnostics**‘ blood lead testing systems. Magellan responded this month that it has initiated remediation activities.

In October, **All Awareness Technology** announced an exclusive distribution agreement with **Vesta Tajhiz Part** for Iran.

Gene-based Consumables

Company Announcements

In September, **Lucigen**, which offers products and services for life science research, entered into a License and Knowledge Transfer Agreement with **Illumina** to manufacture and sell the entire Epicentre product line (see ***IBO*** 12/15/16).

Desktop Genetics, which uses artificial intelligence to enable scientists to capitalize on genome engineering technology, announced in October a £1.5 million ($1.9 million) investment round.

In October, **Synthego** announced it will manufacture and distribute synthetic guide RNA products for **Thermo Fisher Scientific**. The products will be sold under the Invitrogen TrueGuide brand.

Genome engineering solutions firm **Synthego** announced in October an investment from **Intel Capital**. This is Intel Capital's first financing in bioinformatics related to the CRISPR workflow.

In October, **Double Helix Technologies** (**Doulix**), a provider of products for biological engineering, collaborated with **Agilent Technologies** to promote Agilent's SureVector cloning kits through Double Helix's web platform.

SimPath announced in October the licensing of a cloning system developed by the **DOE's Oak Ridge National Laboratory**. The company will develop the method into a multigene DNA assembly kit and software package for customers who use synthetic biology techniques. The method offers flexible cloning with lower biodesign restrictions, and can be automated so that multiple genes can be connected seamlessly.

In October, **MilliporeSigma** announced that the **Canadian Patent Office** has issued a "Notice of Allowance" for the company's patent application covering its CRISPR technology used in a genomic-integration method for eukaryotic cells.

Product Introductions

In September, **Horizon Discovery** launched genome-wide CRISPRi (interference) and CRISPRa (acitivation) screening services. CRISPRi and CRISPRa reduce or increase, rather than eliminate, gene expression.

Cellecta launched in October CRISPRa and CRISPRi genome-wide human and mouse pooled screening libraries, as well as added a Mouse Genome-Wide CRISPR Knockout Library. The CRISPRa and CRISPRi libraries features a single-module format and average five sgRNAs per gene promoter region.

In October, **Bruker** introduced the CE-IVD marked Fungiplex Candida diagnostic assay, a multiplex real-time PCR test, which tests for the most common pathogens associated with invasive candidiasis and does not require any culture steps. Bruker also released the MICRONAUT-AM (AntiMycotics), a test plate for the automated or manual antifungal susceptibility testing of yeasts from cultures. Both products are from the recently acquired **MICRONAUT Diagnostika** business (see ***IBO*** 9/30/17).

Sales/Orders of Note

In October, **Twist Bioscience** expanded its supply agreement with **Ginkgo Bioworks** to include genes up to 5 kb in in length.

Cell-based Consumables

Company Announcements

Oxford BioMedica announced that it is the lead partner in a two-year, £2 million ($3 million) project as part of a consortium to explore and apply novel advanced technologies to further evolve its suspension LentiVector platform for gene and cell therapy manufacturing. Consortium members are the **Cell and Gene Therapy Catapult**, **Stratophase** and **Synthace**. The project is cofounded by **Innovate UK**.

In September, the **Gene Editing Institute of the Helen F. Graham Cancer Center & Research Institute at Christiana Care Health Systems** announced it will exclusively provide genetically modified cell lines and services to **Analytical Biological Services**, a supplier of cells and tissues, under a three-year agreement.

In September, **STEMCELL Technologies** signed an exclusive agreement to commercialize regenerative medicine firm **Propagenix**'s EpiX technology, a cell culture medium for expansion of tissue-resident epithelial stems cells without any genetic manipulation.

Scientist.com and **Astarte Biologics** announced a partnership in October under which Scientist.com will offer online access to Astarte's immune cell products and research services.

In October, nanoelectronic and digital technology firm **Imec** has joined the **EU**'s 2-year, €0.5 million ($0.5 million) **ORgan-on-CHip In Development (ORCHID)** project, as part of a consortium of academic and private partners, including 6 research institutes. The project will facilitate the dialogue and documents towards accelerating the development of prototypes of organs-on-chips, validating cell systems that mimic diseased or healthy human tissues, and implementation of this technology by a broad group of potential users.

Product Introductions

In September, **Thermo Fisher Scientific** launched the Gibco B-27 Plus Neuronal Culture System, a media system designed to enable reliable and biologically relevant in vitro neuronal cell models by increasing survival of neurons.

Irving Scientific introduced in September the PRIME-XV Dendritic Cell Maturation chemically defined medium for immunotherapy applications. It enables the differentiation of monocytes into immature dendritic cells and subsequence maturation in dendritic cells.

Protein-based Consumables

Company Announcements

In October, **Abcam** announced that Chairman Murray Hennessy will resign in November, having accepted a CEO position.

Product Introductions

ArcticZymes released in September the SAN HQ ELISA immunoassay product, which is targeted at detecting DNA contamination during biomanufacturing.

Promega launched in August the new bioluminescent HiBiT Protein Tagging System for measuring protein trafficking or protein secretion. It features an antibody-free protocol and requires only a luminometer for detection.

In September, **Genovis** named **Chinese Beijing Zhongyuan** as a Chinese distributor.

Sales/Orders of News

In October, **Bio-Techne** announced in October an agreement to supply research antibodies under "Lot 1: Antibodies of the **Southern Universities Purchasing Consortium**, Antibodies and Sera Framework Agreement for the **UK Higher Education Segment**." The Framework serves 6 major UK-based academic consortia and supports over 100 research centers. The agreement runs through June 30, 2019, with an option to extend a further two years. This is the first collaborative agreement of its kind.

Sample Preparation

Company Announcements

In October, **Pressure Biosciences** announced a collaboration with **Phasex**, a supercritical fluid–based processes services firm. Phasex will use Pressure Biosciences' Ultra Shear Technology to enable the development of stable, water-soluble nanoemulsions of nutraceuticals.

Zymo Research announced in October a joint agreement with **VWR** to sell and distribute its DNA purification, RNA extraction, microbiomic analysis and epigenetics products throughout North America.

Product Introductions

ReSyn Biosciences released a range of integrated high-performance magnetic reagents for manual and automated SPE-based cleanup prior to MS injection.

Cole-Parmer launched in August the Arcis DNA Prep Kit for DNA and RNA extraction in three minutes with two steps.

In September, **Thermo Fisher Scientific** introduced the PureLink Fast Low-Endotoxin Plasmid Purification Midi and Maxi Kits for low-endotoxin plasmid DNA isolation. The kits allow isolation of transfection-quality plasmid in about 30 minutes. The Kits are based on silica membrane–based columns and the Thermo Scientific FastVac vacuum manifold.

Biotage released in September the EVOLUTE HYDRO SPE plates with the ability to perform sample hydrolysis within the walls of the extraction plate, followed directly by sample cleanup using SPE without the need for sample transfer. CX (mixed-mode strong cation exchange) and ABN (wettable/nonpolar) phases are currently available.

In October, **CEM** debuted the EDGE (Energized Dispersive Guided Extraction) extraction system for rapid sample preparation of GC and LC samples. It combines traditional pressurized fluid extraction with dispersive SPE. A complete solution, it combines analyte extraction and sample cleanup in a rapid single-step procedure. Preparation time is as little as 5 minutes, and 12 samples per hour can be processed.

Sales/Order of Notes

In October, **Circulomics** won a $1.7 million US **Small Business Innovation Research** grant to develop new applications for its Nanobind DNA/RNA extraction technology. Including this grant, the company's funding totals $8 million.

Bioprocess Analysis

Company Announcements

In August, **MilliporeSigma** began a collaboration with **Angiex**, a developer of vascular-targeted biotherapeutic, to speed its lead oncology antibody drug candidate in clinical use. This is the first project for MilliporeSigma's Massachusetts BioReliance End-to-End Solutions center.

MilliporeSigma opened in September its first BioReliance End-to-End Biodevelopment Center in Asia Pacific, located in Shanghai, China. Services provided by the facility include cell line development, upstream and downstream process development, and non-GMP clnical production. It will host small-scale drug manufacturers working on early-phase clinical trials.

In September, **MilliporeSigma** provided an update on its participation in the **EU Horizon 2020**'s **nextBioPharmaDSP** project, led by **Lek Pharmaceuticals**, a **Sandoz** company. The project, undertaken by a consortium of seven public and private organizations, is developing a more efficient, cost effective and environmentally friendly downstream process to manufacture mAbs. MilliporeSigma is providing expertise in continuous and flow-through downstream processing approaches and single-use systems. Recently, the project completed an 18 month milestone submission to the EU. Developments include a disposable continuous chromatography system with novel analytical tools and sensors, which are also implemented in other parts of the downstream process.

In October, **MilliporeSigma** announced the completion of a **US FDA** Pre-License Inspection and **EMA** Marketing Authorization Application inspection of its Carlsbad, California–based manufacturing facility for the production of BioReliance viral and gene therapy products.

Sartorius Stedim Cellca, which currently employees 90 people, broke ground in September on a €30 million ($33 million) Cell Culture Technology Center in Ulm, Germany. The new lab and office complex will approximately double the company's space and is expected to be completed by the end of 2019.

Product Introductions

In September, **Esco VacciXcell** launched the new TideCell bioreactor in the US. The company calls it the world's largest single-use linearly scalable bioreactor for adherent cell scale up to 5,000 L packed-bed volume. New features include a standard hypoxic condition (suppressed oxygen) that is optimal for the growth of bone marrow–derived mesenchymal stem cells and exosomes, as well as the PC-based monitoring and control system.

Sales/Orders of Note

In September, **Sartorius Stedim Biotech** announced the purchase of its ambr 250 modular bioreactor system by industrial biotechnology firm **Ingenza** for fast fermentation development.

MilliporeSigma announced in September the sale of five Mobius single-use bioreactors, 50 L, 200 L and 2,000 L systems, to CDMO firm **Celonic** for its Basel, Switzerland, facility.

In October, **ABEC** announced that **Emergent BioSolutions** will equip its Baltimore, Maryland, bulk manufacturing facility with an ABEC 4,000 L CSR single-use bioreactor.

Process Analysis

Company Announcements

In September, **AdEdge Water Technologies** joined **Endress+Hauser**'s OEM Business Partner Program. The new Program enables a higher level and more strategic OEM customer relationship that is focused on tangible business

results and product development. AdEdge will develop its specifications around Endress+Hauser technologies.

Endress+Hauser inaugurated a new campus in September in Lyon, France. The €4.9 million ($5.4 million) building holds 25 process control employees and its advanced analysis **Kaiser Optical Systems** subsidiary. Endress+Hauser France has more than 250 employees.

In October, **Endress+Hauser** opened a €5 million ($5 million), 7,546 ft^2 (2,300 m^2) building in Santiago, Chile. The sales center is currently home to 44 employees.

Also in October, **Endress+Hauser** announced the dedication of a new €6.6 million ($7.3 million), 11,811 ft^2 (3,600 m^2) facility in Brussels, Belgium.

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Product Introductions

In September, **Metrohm Process Analytics** introduced the online 2026 Titrolyzer, suitable for titrimetric, ion selective or pH measurements, and the 2029 Process Photometer for photometric absorption measurements in the visible light range. Both are available in several application-specific configurations for monitoring up to two process streams.

Hiden Analytical launched in September the Hiden ExQ quantitative gas analyzer, a compact MS system providing continuous on-line analysis of dynamic gas streams at pressures from sub-atmospheric up to 30 bar. A range of process interface options enable direct connection to the majority of standard TGA/TA instruments.

In October, **Mettler-Toledo** debuted the Cross-Pipe GPro tunable diode laser 500 analyzer, which combines the laser source and receiver into a single unit, maintaining the accuracy of the parts' alignment. A 2D corner cube array is positioned in the pipe, opposite the analyzer head, so exact alignment is not required.

Sensorex released in October the SensoPro Toroidal Conductivity Monitoring System, combining the TCS3020 probe with the new EX2000RS transmitter in a single package.

IONICON Analytik introduced in October the CHARON, a new sample introduction system for aerosols for its PTR-TOFMS system. It allows the molecular-level characterization of sub-µm particulate organic matter in real time.

In October, **AMETEK Energy & Process Instrumentation** launched the new WellPro process MS for near real-time quantitative analysis of C1 though C7 components of mud gas in less than 10 sec.

Reported Financial Results

$ in Millions USD	Period	Ended	Sales	Chg.	Op. Prof.	Chg.	Net Prof.	Chg.
Bio-Techne	Q1	30-Sep	$156.6	16.2%	$41.5	3.7%	$28.8	12.4%
Bio-Techne (BioTechnology)	Q1	30-Sep	$97.2	15.2%	$47.9	5.7%	NA	NA
Bio-Techne (Protein Platforms)	Q1	30-Sep	$26.8	22.0%	$4.3	103.1%	NA	NA
Corning	Q3	30-Sep	$2,607.0	4.0%	$453.0	-15.3%	$390.0	37.3%
Corning (Life Sciences)	Q3	30-Sep	$223.0	4.2%	$17.0	6.3%	NA	NA
Danaher	Q3	30-Sep	$4,528.2	9.6%	$767.5	9.8%	$572.1	42.1%
Danaher (Life Sciences)	Q3	30-Sep	$1,392.6	5.1%	$246.8	20.6%	NA	NA
Danaher (Environmental & Applied Solutions)	Q3	30-Sep	$992.9	8.1%	$222.8	-0.3%	NA	NA
Harvard Bioscience	Q3	30-Sep	$25.1	0.2%	($0.1)	83.3%	($0.4)	74.5%
Honeywell (Peformance Material & Tech.)	Q3	30-Sep	$2,260.0	-3.0%	$526.0	4.6%	NA	NA
Illinois Tool Works (Test & Meas., and Elec.)	Q3	30-Sep	$525.0	1.8%	$127.0	16.7%	NA	NA
Illumina	Q3	30-Sep	$714.0	17.6%	$181.0	12.4%	$163.0	26.4%
Luminex	Q3	30-Sep	$74.1	4.1%	$6.5	62.1%	$17.6	540.2%
Roper Technologies	Q3	30-Sep	$1,159.9	22.7%	$348.3	16.7%	$190.3	13.9%
Roper Tech. (Energy Systems & Controls)	Q3	30-Sep	$135.3	8.0%	$36.4	14.4%	NA	NA
Roper Tech. (Medical & Scientific Imaging)	Q3	30-Sep	$343.6	1.7%	$115.5	-2.9%	NA	NA
Thermo Fisher Scientific	Q3	30-Sep	$5,116.2	13.9%	$636.2	17.6%	$533.9	12.8%
Thermo Fisher Sci. (Life Sciences Solutions)	Q3	30-Sep	$1,382.0	5.3%	$453.0	16.8%	NA	NA
Thermo Fisher Sci. (Analytical Instruments)	Q3	30-Sep	$1,189.6	32.5%	$256.6	35.0%	NA	NA
Thermo Fisher Sci. (Specialty Diagnostics)	Q3	30-Sep	$843.7	5.6%	$218.8	2.1%	NA	NA
Thermo Fisher Sci. (Laboratory Prod. & Serv.)	Q3	30-Sep	$1,933.0	15.4%	$243.4	1.4%	NA	NA
Waters	Q3	30-Sep	$565.6	7.4%	$159.0	4.8%	$136.1	9.0%
Xylem	Q3	30-Sep	$1,195.0	33.2%	$152.0	39.4%	$105.0	43.8%
Other Currencies (in Millions)								
Hitachi High-Technologies	Q2	30-Sep	¥ 171,400.0	10.4%	¥ 11,508.0	5.6%	¥ 8,507.0	6.4%
Hitachi High-Tech. (Science & Medical Systems)	Q2	30-Sep	¥ 47,800.0	2.1%	¥ 5,200.0	-1.9%	NA	NA
Sartorius	9 mo.	30-Sep	€1,043.6	8.1%	€163.5	-2.6%	€107.4	-5.0%
Sartorius (Bioprocess Solutions)	9 mo.	30-Sep	€752.9	3.6%	€207.0	2.2%	NA	NA
Sartorius (Lab Products & Services)	9 mo.	30-Sep	€290.7	21.9%	€51.9	34.2%	NA	NA

NA = not available, NM = not meaningful
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